

REMARKS

Claims 29-38, 40-44, and 46-50 are pending in the present application. Claims 30, 40, and 46 were previously withdrawn. The status of the claims set forth in the Office Action dated February 23, 2006, is as follows:

(A) Claims 29, 32-35, 37, and 38 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,082,207 ("Tulinius"); and

(B) Claims 31, 36, 41-44, and 47-50 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tulinius in view of U.S. Patent Application No. 08/917,480 ("Wakayama").

As a preliminary matter the undersigned would like to thank Examiner Holzen for participating in a telephonic Examiner Interview on April 3, 2006. During the Interview, the examiner agreed that Tulinius makes no reference to leading edge device chord length. However, the Examiner was not entirely convinced that the claim language defined over the prior art. The Examiner argued that (1) the length of the leading edge device chord lengths are predetermined by an engineer and (2) that the reason for selecting the specific leading edge device chord length is functional in nature. Additionally, citing *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980), the Examiner asserted that the steps for determining chord length might be obvious.

A. Response to Section 102 Rejections

Independent claim 29 and 35 were rejected under 35 U.S.C. § 102 as being anticipated by Tulinius. As described below, the rejection of these claims should be withdrawn because Tulinius does not teach or suggest all of the features of these claims.

1. Claim 29 is Directed Toward an Aircraft System that Includes a Leading Edge Device Arrangement, Wherein a Leading Edge Device

Chord Length at Each of a Plurality of Spanwise Locations Can Be at Least Approximately Equal to the Smallest Leading Edge Device Chord Length Required to Provide a Local Maximum Lift Coefficient

Claim 29 is directed toward an aircraft system that includes an airfoil having a spanwise portion. The spanwise portion has a plurality of spanwise locations. The system further includes a leading edge device arrangement coupled to the spanwise portion. The leading edge device arrangement includes at least a portion of at least one leading edge device. The at least one leading edge device in turn includes at least a portion of a leading edge flap or leading edge slat. A leading edge device chord length at each of the plurality of spanwise locations is at least approximately equal to the smallest leading edge device chord length required to provide a local maximum lift coefficient when the airfoil is operated at at least one selected design condition and a selected aircraft angle of attack.

2. Tulinius Discloses a System for Controlling an Aircraft Through Aeroelastic Deflection of the Wings

Tulinius discloses a system for controlling an aircraft through aeroelastic deflections of the wings in all modes of flight (col. 2, lines 25-35). Movement of the leading edge and trailing edge wing control surfaces bring about the aeroelastic deflections of the flexible wings for control of the aircraft, optimum cruise, and specific maneuvers (col. 2, lines 25-35). The system can also effect gust load alleviation, flutter suppression, and maneuver load control (col. 2, lines 25-35).

3. Tulinius Fails to Teach or Suggest, Among Other Features, a Leading Edge Device Arrangement, Wherein a Leading Edge Device Chord Length at Each of a Plurality of Spanwise Locations Can Be at Least Approximately Equal to the Smallest Leading Edge Device Chord Length Required to Provide a Local Maximum Lift Coefficient

Tulinius makes no reference to a leading edge device chord length at each of the plurality of spanwise locations being at least approximately equal to the smallest leading edge device chord length required to provide a local maximum lift coefficient. In fact, Tulinius makes no reference to any leading edge device chord length. Accordingly,

Tulinius does not teach or suggest a leading edge device chord length at each of the plurality of spanwise locations that can be at least approximately equal to the smallest leading edge device chord length required to provide a local maximum lift coefficient when the airfoil is operated at at least one selected design condition and a selected aircraft angle of attack.

Furthermore, a leading edge device chord length at each of the plurality of spanwise locations that is at least approximately equal to the smallest leading edge device chord length required to provide a local maximum lift coefficient is materially different than a wing that is aeroelastically deflected to minimize drag for a given flight condition, as disclosed in Tulinius (col. 4, lines 26-30). Thus, while the Examiner suggests that there is no material difference between minimizing drag and maximizing lift, the undersigned respectfully disagrees. Drag and lift are distinctly different aerodynamic forces. As a result, the techniques used to minimize drag can be significantly different than the techniques used to maximize lift. In fact, the techniques used to maximize lift generally cause an increase in drag.

Additionally, a leading edge device chord length at each of the plurality of spanwise locations that is at least approximately equal to the smallest leading edge device chord length required to provide a local maximum lift coefficient is materially different than minimizing drag or maximizing lift. For example, a local maximum lift coefficient is not analogous to maximizing lift. Lift on a wing is generally a function of lift coefficient, dynamic pressure, and wing area. Lift coefficient is generally a function of angle of attack. Accordingly, for a selected angle of attack, lift will increase as dynamic pressure increases even though the lift coefficient remains constant (even when the airfoil is at an angle of attack corresponding to the maximum lift coefficient). This is true for an entire airfoil when looking at a plot of angle of attack versus lift coefficient for the airfoil, or for local portions of the airfoil (e.g., spanwise locations) when looking at a plot of angle of attack versus lift coefficient for the local portion of the airfoil.

Typically, as angle of attack increases, the lift coefficient will increase until the stall angle of attack is reached, and then decrease as angle of attack increase beyond the stall angle of attack. In many cases, for an airfoil or local portion of an airfoil, the maximum lift coefficient can be increased and/or the stall angle of attack can be increased by increasing the leading edge device chord length. Accordingly, because an airfoil has a leading edge device chord length at each of the plurality of spanwise locations that is at least approximately equal to the smallest leading edge device chord length required to provide a local maximum lift coefficient does not mean that lift has been maximized, drag has been minimized, or that the local maximum lift coefficient has been maximized or optimized.

In claim 29, the system includes a leading edge device wherein a leading edge device chord length at each of the plurality of spanwise locations can be at least approximately equal to the smallest leading edge device chord length required to provide a local maximum lift coefficient when the airfoil is operated at at least one selected design condition and a selected aircraft angle of attack. For example, for stability and control purposes, in selected embodiments a designer can tailor chord length of the leading edge device so that the wing stalls at a lower angle of attack than might be possible with other chord lengths (application para. 47). Accordingly, a leading edge device chord length at each of the plurality of spanwise locations that can be at least approximately equal to the smallest leading edge device chord length required to provide a local maximum lift coefficient is materially different than minimizing drag on an aircraft or maximizing lift on aircraft.

For at least the foregoing reasons, Tulinius fails to provide adequate basis for a prima facie case of anticipation under Section 102. Therefore, claim 29 is in condition for allowance. Claims 30-34 depend from claim 29. Therefore, for at least this reason, and for the additional features of these claims, claims 30-34 are also in condition for allowance. Claim 35 includes, *inter alia*, features similar to claim 29. Accordingly, for at least this reason, and for the additional features of this claim, claim 35 is in condition for allowance.

Claims 36-38 depend from claim 35. Therefore, for at least this reason, and for the additional features of this claim, claims 36-38 are also in condition for allowance.

B. Response to Section 103 Rejections

Independent claim 41 and 47 were rejected under 35 U.S.C. § 103 as being unpatentable over Tulinius in View of Wakayama. As described below, the rejection of these claims should be withdrawn because the combination of Tulinius and Wakayama does not teach or suggest all of the features of these claims.

1. Claim 41 is Directed Toward an Aircraft System that Includes a Leading Edge Device Arrangement, Wherein a Leading Edge Device Chord Length at Each of a Plurality of Spanwise Locations Can Be at Least Approximately Proportional to a Leading Edge Device Chord Length at Each Location Determined to Provide a Selected Lift Coefficient Distribution

Claim 41 is directed toward an aircraft system that includes an airfoil having a spanwise portion. The spanwise portion can have a plurality of spanwise locations. The system can further include a leading edge device arrangement coupled to the spanwise portion. The leading edge device arrangement can include at least a portion of at least one leading edge device. The at least one leading edge device in turn can include at least a portion of a leading edge flap or leading edge slat. A leading edge device chord length at each of the plurality of spanwise locations can be at least approximately proportional to a leading edge device chord length at each location determined to provide a selected lift coefficient distribution when the airfoil is operated at at least one selected design condition and at least one selected aircraft angle of attack. The leading edge device arrangement can have at least two tapered portions, including a first tapered portion wherein the leading edge device chord length is tapered in a first spanwise direction and a second tapered portion wherein the leading edge device chord length is tapered in a second spanwise direction approximately opposite the first direction. The leading edge device chord length can vary in a manner at least approximately the same as the manner in which the leading

edge device chord length at each location determined to provide the selected lift coefficient distribution varies across the spanwise portion.

2. Wakayama Discloses a System to Deflect Control Surfaces to Optimize the Spanwise Lift Distribution Across a Wing

The discussion of Wakayama herein addresses the relevant embodiments disclosed in the specification and figures of Wakayama, and in no way is a characterization or interpretation of the claims in Wakayama. The claims in Wakayama, moreover, are expressly not limited to the embodiments disclosed in the specification of Wakayama. Therefore, the claims in Wakayama are to be interpreted without reference to this paper. Wakayama discloses a system with independently deflectable control surfaces located on the trailing edge of a wing of a blended wing-body aircraft (para. 7). The amount and direction of the deflection of each control surface is determined so as to optimize the spanwise lift distribution across the wing for a variety of flight conditions (para. 7).

3. Tulinius and Wakayama Fail to Teach or Suggest, Among Other Features, a Leading Edge Device Arrangement, Wherein a Leading Edge Device Chord Length at Each of a Plurality of Spanwise Locations Can Be at Least Approximately Proportional to a Leading Edge Device Chord Length at Each Location Determined to Provide a Selected Lift Coefficient Distribution

Wakayama, like Tulinius, makes no reference to a leading edge device chord length at each of the plurality of spanwise locations being at least approximately proportional to a leading edge device chord length at each location determined to provide a selected lift coefficient distribution. In fact, Wakayama makes no reference to any leading edge device chord length or to tapering any leading edge device. Accordingly, Tulinius and Wakayama fail to teach or suggest a leading edge device chord length at each of the plurality of spanwise locations that can be at least approximately proportional to a leading edge device chord length at each location determined to provide a selected lift coefficient distribution when the airfoil is operated at at least one selected design condition and a selected aircraft angle of attack. Additionally, Tulinius and Wakayama do not teach or

suggest tapering first and second portions of a leading edge device in at least approximately opposite directions, as recited in claim 41.

Furthermore, a leading edge device chord length at each of the plurality of spanwise locations being at least approximately proportional to a leading edge device chord length at each location determined to provide a selected lift coefficient distribution is materially different than a trailing edge control surface of a wing being deflected to optimize the spanwise lift distribution across the wing for a variety of flight conditions. Controlling a spanwise lift distribution by deflecting a trailing edge control surface does not teach or suggest a leading edge device chord length at each of the plurality of spanwise locations being at least approximately proportional to a leading edge device chord length at each location determined to provide a selected lift coefficient distribution. Accordingly, Tulinius and Wakayama fail to teach or suggest a leading edge device chord length at each of the plurality of spanwise locations being at least approximately proportional to a leading edge device chord length at each location determined to provide a selected lift coefficient distribution, or tapering first and second portions of a leading edge device in at least approximately opposite directions.

For at least the foregoing reasons, the applied references fail to provide a basis for a prima facie case of obviousness under section 103. Therefore, claim 41 is in condition for allowance. Claims 40 and 42-44 depend from claim 41. Therefore, for at least this reason, and for the additional features of these claims, claims 40 and 42-44 are also in condition for allowance. Claim 47 includes, *inter alia*, features similar to claim 41. Accordingly, for at least this reason, and for the additional features of this claim, claim 47 is in condition for allowance. Claims 46 and 48-50 depend from claim 47. Therefore, for at least this reason, and for the additional features of these claims, claims 46 and 48-50 are also in condition for allowance.

The undersigned respectfully requests that claims 30, 40, and 46 be rejoined and allowed because these claims depend from and are directed to non-elected species of allowable generic claims 29, 41, and 47, respectively.

C. Response to the Functional Language Argument

The claim language in independent claims 29, 35, 41, and 47 is structural in nature, and even if the language were considered to be functional in nature, the language is appropriate and patentable under 35 U.S.C. 112 and MPEP 2173.0(g). Claims 29 and 35 include language generally directed at an aircraft system with a leading edge device or high lift means chord length at each of the plurality of spanwise locations that is at least approximately equal to the smallest leading edge device or high lift means chord length required to provide a local maximum lift coefficient when an airfoil is operated at at least one selected design condition and a selected aircraft angle of attack. The leading edge device and the plurality of leading edge device or high lift means chord lengths recited in these claims are structural or physical elements.

Additionally, even if the foregoing phrase were considered to be functional in nature, according to MPEP 2173.0(g) there is nothing inherently wrong with defining some features of a claim using functional terms. The MPEP goes on to state that functional language does not, in and of itself, render a claim improper; a functional feature must be evaluated and considered, just like any other feature of the claim, for what it fairly conveys to a person of ordinary skill in the pertinent art in the context in which it is used. The MPEP further states that a functional feature is often used in association with an element, ingredient, or step of a process to define a particular capability or purpose that is served by the recited element, ingredient or step. Accordingly, the language in claims 29 and 35 complies with 35 U.S.C. 112.

Claims 41 and 47 include language generally directed toward an aircraft system with a leading edge device arrangement having at least two tapered portions, including a

first tapered portion wherein the leading edge device chord length is tapered in a first spanwise direction and a second tapered portion wherein the leading edge device chord length is tapered in a second spanwise direction approximately opposite the first direction. In claim 41, the leading edge device chord length varies in a manner at least approximately the same as the manner in which the leading edge device chord length at each location determined to provide a selected lift coefficient distribution varies across the spanwise portion. In claim 47, the first and second portions have a combined distribution of chord lengths at least approximately the same as determined leading edge device chord lengths, wherein a leading edge device chord length at each of the plurality of spanwise locations is at least approximately proportional to the leading edge device chord length at each location determined to provide a selected spanwise distribution of aircraft angles of attack corresponding to local maximum lift coefficients when the airfoil is operated at at least one selected design condition.

As discussed above, the leading edge device, the tapered portion, and the varying leading edge device chord lengths recited in these claims are structural or physical elements. Additionally, as discussed above, even if the manner in which the leading edge device chord length varies were considered to be functional in nature, according to MPEP 2173.0(g) there is nothing inherently wrong with defining some features of a claim using functional terms. Accordingly, the language in claims 41 and 47 also complies with 35 U.S.C. 112.

D. Response to the Obviousness Assertion

Independent claims 29, 35, 41, and 47 are not obvious because one skilled in the art would not arrive at the claimed subject matter without the teachings of the present application and the use of impermissible hindsight. During the above referenced Examiner Interview, the Examiner asserted that the steps for determining a chord length might be obvious, citing *In re Boesch* to support this premise. The applicant respectfully disagrees.

In re Boesch stands for the proposition that the discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art. A result-effective variable is a variable which achieves a recognized result (MPEP 2144.05). Claims 29 and 35 include language generally directed to an aircraft system with a leading edge device or high lift means chord length at each of the plurality of spanwise locations that can be at least approximately equal to the smallest leading edge device or high lift means chord length required to provide a local maximum lift coefficient when an airfoil is operated at at least one selected design condition and a selected aircraft angle of attack. There is no reference to optimization of any parameter in claims 29 and 35. For example, as discussed above maximum lift coefficient is a characteristic of an airfoil or airfoil portion and does not mean that the lift coefficient has been optimized. The language in claim 29 and 35 is directed toward a leading edge device or high lift means chord length at each of the plurality of spanwise locations that is at least approximately equal to the smallest leading edge device or high lift means chord length required to provide a local maximum lift coefficient when the associated airfoil is operated at at least one selected design condition and a selected aircraft angle of attack. This is different than optimizing a value of a result effective variable, as discussed in *In re Boesch*.

Furthermore, unlike with current leading edge designs, the language in claims 29 and 35 is directed toward a leading edge device or high lift means chord length at each of the plurality of spanwise locations that is at least approximately equal to the smallest leading edge device or high lift means chord length required to provide a local maximum lift coefficient when the associated airfoil is operated at at least one selected design condition and a selected aircraft angle of attack. As disclosed in the Background section of the present application:

The typical design process, which yields the design depicted in Figure 1, includes determining the amount of lift that the wing 1 must provide during various phases of flight, and an aircraft angle of attack that will be required to generate this lift. Because longer leading edge device chord lengths generally provide better high angle of attack

performance, *a leading edge device chord length that will support the required aircraft angle of attack on the critical portion of the wing 1 is determined. Generally, this leading edge device chord length determined for the critical portion of the airfoil is then used for all portions of all leading edge devices on the airfoil* (i.e., each leading edge device has the same, constant chord length).

Occasionally, a smaller chord length is used (for installation reasons) near the wing tip 17 due to spanwise wing taper or other structural constraints [emphasis added].

Because the leading edge device chord length is constant on wings designed in accordance with current practices, $C_{l_{max}}$ generally does not occur at at least approximately the same angle of attack across a spanwise portion of the wing. In fact, with current systems, manufactures often add stall strips, vortex generators, and other aerodynamic devices to tailor the spanwise lift distribution at various angles of attack. Accordingly, one skilled in the art would not arrive at the claimed subject matter without the teachings of the present application and the use of impermissible hindsight.

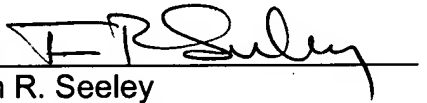
Claims 41 and 47 include language generally directed toward an aircraft system with a leading edge device arrangement having at least two tapered portions, including a first tapered portion wherein the leading edge device chord length is tapered in a first spanwise direction and a second tapered portion wherein the leading edge device chord length is tapered in a second spanwise direction approximately opposite the first direction. In claim 41, the leading edge device chord length can vary in a manner at least approximately the same as the manner in which the leading edge device chord length at each location determined to provide a selected lift coefficient distribution varies across the spanwise portion. In claim 47, the first and second portions can have a combined distribution of chord lengths at least approximately the same as determined leading edge device chord lengths, wherein a leading edge device chord length at each of the plurality of spanwise locations can be at least approximately proportional to the leading edge device chord length at each location determined to provide a selected spanwise distribution of aircraft angles of attack corresponding to local maximum lift coefficients when the airfoil is operated at at least one selected design condition.

There is no reference to optimization of any parameter in claims 41 and 47. The language in claims 41 and 47 is directed toward a variation in leading edge device chord length can varying in the manners discussed above. This is different than optimizing a value of a result effective variable, as discussed in *In re Boesch*. Additionally, as discussed above, one skilled in the art would not arrive at the claimed subject matter without the teachings of the present application and the use of impermissible hindsight.

In view of the foregoing, the pending claims comply with 35 U.S.C. § 112 and are patentable over the applied art. The applicant accordingly requests reconsideration of the application and a Notice of Allowance. If the Examiner has any questions or believes a telephone conference would expedite prosecution of this application, the Examiner is encouraged to call the undersigned representative at (206) 359-6477.

Dated:

Respectfully submitted,

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